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It remains to observe that the phenomena of exact parallelism, or palingenesis, are quite as necessarily accounted for on the principle of acceleration or retardation as are those of inexact parallelism, or cœnogenesis. Were all parts of the organism accelerated or retarded at a like rate, the relation of exact parallelism would never be disturbed, while the inexactitude of the parallelism will depend on the number of variations in the rate of growth of different organs of the individual, with additions introduced from time to time. Hence it may be laid down that synchronous acceleration or retardation produces exact parallelism, and heterochronous acceleration or retardation produces inexact parallelism.

In conclusion, it may be added that acceleration of the segmentation of the protoplasma or animal portion of the primordial egg, or retardation of segmentation of the deutoplasma or vegetative half of the egg, or both, or the same relation between the growth of the circumference and centre of the egg, has given rise to the four types which the segmentation now presents. This analysis of the laws of evolution was tabulated as follows: —

		Exact parallelism produced by *palingenesis*, which is synchronous	*Inexact parallelism* produced by *cœnogenesis*, which is heterochronous
acceleration, which proceeds by	Exact repetition.	*	*
	Modified repetition.	*	*
	Heterotopy.	*	*
retardation, which proceeds by	Exact atrophy.	*	*
	Modified atrophy.	*	*

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THE FLORA OF GUADALUPE ISLAND, LOWER CALIFORNIA.[1]

BY SERENO WATSON.

THE island of Guadalupe is in latitude twenty-nine degrees north, about one hundred miles from the coast of Lower California, and two hundred and thirty west of south from the town of San Diego, which is near the southern line of California. It is twenty-six miles in length in a north and south direction, with an average breadth of ten miles, and is traversed by a mountain ridge, the central peak (Mount Augusta) having an elevation of 3900 feet above the level of the sea. From this point the nearest main-land is visible. The sides of the ridge are exceedingly rough and broken, cut up by numerous deep and rocky cañons, and even the more level surfaces are described as usually covered by rocks of every size and form. The rocks are volcanic, and several extinct craters still exist.

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[1] Extract from the Proceedings of the American Academy of Arts and Sciences, vol. xi.

The island lies within the great ocean current which flows from the peninsula of Alaska down our western coast, the continuation of what is known as the Japanese Gulf-Stream, and in the zone of the northwest trade-winds. Fogs are very prevalent, especially in the winter months (from November to February), when they are driven by the winds over the crest of the island, covering all the northern end and filling the upper portions of the cañons, while the lower cañons and the southern extremity of the island remain clear and warm. These winter winds from the northwest are described as strong and cold, sometimes extremely so, an instance of which occurred during December, 1874, when ice an inch in thickness was formed in the middle of the island, accompanied by two inches of snow, which was followed by hail and five days of cold rain. In summer these winds have less force, though still brisk and chilly for much of the time; and the fogs, instead of being carried over the central ridge, are driven around the northern end, and by eddy-winds are borne into the lower cañons of the eastern side, which are thus made cooler than the region above them. Otherwise the summer months are intensely hot, especially in the southern portion of the island, and the soil becomes soon everywhere so dry that the effect of the temporary summer fogs upon the vegetation is slight. The difference in the seasons, however, at the two extremities of the island is remarkable, as vegetation at the southern end and in the eastern cañons is at least two months earlier than in the northern and western portions, and has for the most part reached its maturity by the close of May, under the then established heats of summer. The annual amount of actual rain-fall is very variable, there being an abundance in some years, and in others little or none.

Guadalupe was early known to the navigators of these seas, but it was never permanently occupied. There are evidences of its temporary occupation by shipwrecked sailors, and it was also long ago stocked with goats[1] for the purpose of supplying fresh meat to vessels short of provisions or suffering from scurvy, and, though out of the general course of travel, it has been occasionally visited on this account. Twelve years ago an expelled governor of Lower California took refuge here with his family, and remained for two years. Soon afterward a party of men from the same state lived for some months upon the island, engaged in killing the goats. During the last ten years it has been occupied by a California company, by whom it was purchased for the purpose of raising the Angora goat, and the island is now overrun by these animals. Several men are kept in continual charge of them, and regular visits are made by the vessels of the company.

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[1] It is said that this was done by Captain Cook, who, however, was never upon this part of the coast. Vancouver passed near the island in 1793, but without stopping.

With thus much of preliminary remark upon those conditions which must affect the vegetation of the island, we may pass to the flora itself. As respects the probable sources from which this flora may have been derived, it is evident that there has been abundant opportunity for the introduction of some species by human agency. These should be especially expected near the usual landing-place upon the eastern side, excepting such as would be probably distributed through the island by means of the goats. Those of most recent introduction in this way would doubtless be Californian; the older might be from the nearer peninsula or from other localities. Of other recognized agencies for the distribution of plants, — the winds, ocean currents, and birds, — the prevalent direction of the first from the northwest is adverse to the supposition that any species of phænogamous plants, at least, would be so introduced. The ocean currents might be considered as more favorable, and as likely to bring accessions from the Californian main-land, contributed from the interior by the Sacramento and other smaller streams. But the winds here again would prove an interposing agency, and by creating a surface-drift toward the coast would prevent floating seeds from attaining any great distance from it. Such as did succeed in reaching the island, and in obtaining and maintaining a foothold upon it, would probably be wholly Californian. Less certain conclusions might be expected in regard to the agency of birds, but it appears, from the collection of the birds of the island made by Dr. Palmer, that they are all in some measure peculiar to the island itself, "consisting almost entirely of familiar forms of the birds of the Western United States, but showing marked peculiarities, entitling them to recognition as geographical varieties. Nothing Mexican about them in the slightest degree." [1] So that, though they demonstrate a connection between the island and California, yet they also indicate that that connection has been only at a remote period, and that their participation in the introduction of plants must have been slight.

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[1] Prof. Spencer F. Baird, in letter.

It might therefore be conjectured, if the island were of comparatively recent formation and always disconnected from the main-land, that its flora would show a meagre list of species almost wholly Californian. Or if, on the other hand, it had at some time been connected with the continent, that then its vegetation would be similar to that of the adjacent peninsula, unless some counteracting influence should have been at work, as would seem to be true of the birds.

To show to what extent the flora of Lower California differs from that of California proper, reference may be made to the list of plants collected by Xantus at the lower extremity of the peninsula,[1] as given by Dr. Gray in the sixth volume of the Proceedings of this Academy. Of the one hundred and eighteen phænogamic species there enumerated, only six are probably found even in extreme Southern California, while thirty others range northward only as far as Sonora, or eastward through Mexico to New Mexico or Texas, the remainder being peculiar to the peninsula or exclusively Mexican. The peninsula shares in this difference with Mexico itself, the type of whose whole flora accords rather with that of the eastern portion of the continent northward, except so far as it would necessarily be affected by the more tropical character of the climate. Of this a good and sufficient illustration is seen in the fact that of the *Phaseoleæ*, a tribe which is well represented in all the Atlantic States, Texas, Southern New Mexico, Eastern Arizona, Sonora, Lower California, and all of Mexico southward, not one species is found within the limits of California, nor in the interior basin west of the Rocky Mountains.

The only collection that we have of the plants of Guadalupe is that made by Dr. Edward Palmer during the last season, from February to May, which is probably as complete as was possible, though attended with much labor and difficulty. He visited all parts of the island, often finding it necessary to reach places which the goats had found inaccessible, in order by means of ropes and poles to secure rare specimens of species which appeared to have been elsewhere completely extirpated. The entire number of species is one hundred and thirty-one, including one hundred and two exogenous and eight endogenous, the remaining twenty-one belonging to the higher cryptogamic orders, — ferns, mosses, and liverworts. Omitting a single phænogamous species (a *Heuchera*), of which the material is insufficient for a satisfactory determination, the remaining one hundred and nine may be divided into five groups: (1) Introduced species, of which there are twelve; (2) those that range from the Pacific to the Atlantic States, of which there are nine; (3) those that are found throughout California, or at least as far north as San Francisco, numbering forty-nine; (4) those found only in Southern California, below Los Angeles, or in Arizona, numbering eighteen; lastly, those peculiar to the island itself, of which there are twenty-one.

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[1] The island of Guadalupe is equally distant from San Francisco and Cape San Lucas, but three degrees of latitude nearer to the latter point; and the difference of latitude between the cape and San Diego is little greater than that between Guadalupe and San Francisco.

The twelve species[1] of whose comparatively recent introduction there can be little doubt are all of European origin, and chiefly from Southern Europe, and are all also found more or less widely naturalized in California. The original introduction of most is probably due to the Spaniards, at least upon the mainland, where the extent to which several have become distributed is something marvelous. The most remarkable is the Alfilaria (*Erodium cicutarium*), which, unlike the wild oat (*Avena fatua*), has not been limited in its range to the western side of the Sierra Nevada, but is found through much of the interior, from New Mexico to Washington Territory. On Guadalupe it is found everywhere, and is more abundant than any other plant. Another species of the same genus (*E. moschatum*), provided with the same contrivances for securing the dissemination and planting of its numerous seeds, occurs less frequently both here and in California; probably because, requiring more moisture, it is unable to maintain itself where the other will flourish. Another instance is the *Oligomeris subulata* of India, Egypt, and the Canary Islands, found also in Southern California, and common eastward through the valleys of the Lower Colorado and of the Gila to the Rio Grande, and in Northern Mexico. It is difficult to account for the wide-spread distribution of this plant, if of recent introduction, through a region so desert and sparsely inhabited.

Besides these twelve species placed in the first group, there are two others, also found in California, which are considered identical with South American forms (*Specularia biflora* and *Amblyopappus pusillus*), possibly introduced from Chili or Peru, perhaps indigenous to both regions. Their presence on Guadalupe would perhaps rather favor the belief that they are native to our western coast, especially as five other South American species, or forms of them, occur in the Guadalupe flora (*Jillæa minima*, *Gilia pusilla*, *Plantago Patagonica*, *Parietaria debilis*, and *Muhlenbergia debilis*), which are more or less frequent in California and eastward in the centre of the continent, and are generally admitted to be native. There are, therefore, ninety-seven phænogamous plants which may be considered as indigenous.

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[1] *Brassica nigra; Oligomeris subulata; Silene Gallica; Malva borealis; Erodium cicutarium* and *E. moschatum; Sonchus oleraceus; Anagallis arvensis; Solanum nigrum; Chenopodium album; Avena fatua; Bromus sterilis.*

It is evident, therefore, that, as regards the species common to the island and the main-land, the flora may be said to be exclusively Californian in its character. Not a single species is found that is peculiar to Lower California or Mexico. The same alliance is nearly as prominent if we look at the twenty-one new phænogamous species of the island. Fifteen of these (a *Thysanocarpus*, a *Sphæralcea*, a *Lupinus*, a *Trifolium*, an *Œnothera*, a *Megarrhiza*, a *Galium*, a *Hemizonia*, a *Perityle*, a *Bæria*, a *Mimulus*, a *Pogogyne*, a *Calamintha*, a *Phacelia*, and an *Atriplex*) belong to genera largely or exclusively represented in California and the region east of it, and are mostly closely allied to the species of that region. The remaining six species include a *Lavatera*, a composite, a borraginaceous plant, a species allied to the olive, and finally a palm. The *Lavatera* is interesting as representing a widely scattered genus, not otherwise found in America, except as a second species occurs on the more northern island of Anacapa. The genus belongs chiefly to the region of the Mediterranean, where fourteen species are native; two others are confined to the Canary Islands; another has been discovered in Central Asia, and still another in Australia. The new composite is referred by Dr. Gray to a South American genus (*Diplostephium*), not otherwise represented in our flora, but of which there are eighteen species in the Andes from the equator southward. Of the borraginaceous and oleineous species Dr. Gray forms new genera; the one (*Harpagonella*) allied to the small genus *Pectocarya*, of which there is one Chilian species and two Californian, one of these also in the Guadalupe flora; the other (*Hesperelæa*) bearing no close resemblance to any other member of the olive family. On the other hand, the palm (*Brahea* (?) *edulis*), conspicuous on the island as the only representative of a tropical flora, is probably less nearly related to the Central Mexican genus to which it is provisionally referred, than to the genus *Livistona* of Australia. A congener of the Guadalupe species has recently been detected by Dr. Palmer in the cañons of the Tantillas Mountains, near San Diego. . . .

As respects the cryptogamic vegetation, of the half a dozen ferns, all are frequent in California, one peculiar to the southern part of the State, another found throughout North America and Europe. Of the eleven mosses, two are strictly Californian species, seven are common everywhere in the United States and Europe, and two are European species which had not previously been detected in America. Of the four *Hepaticæ*, three are Californian and one is considered new.

Reference should be made to the plants which by their abundance and prominence give character to the vegetation. Among these the "sage-brush" and "grease-woods" of the valleys of the basin are duly represented by an *Artemisia* and an *Atriplex*, which share with a *Franseria* in covering large tracts, and in protecting the soil and the smaller annuals from the winds and sun. Trees are numerous over much of the island, chiefly coniferous: a pine, belonging to a Southern Californian species, but peculiar in some of its characters; a juniper, common in California; a cypress, similar to and perhaps identical with a Mexican species which extends into California; and a small oak, which is common throughout the State. To these is to be added the palm, which is frequent in the southern cañons, growing to a height of forty feet, and bearing large clusters of edible fruit.

To conclude, it is apparent, from all that has been said, that this little flora as a whole is to be considered a part of that of California, as distinct from the flora of Mexico. It may be inferred also that it has not been to any great extent derived from California by any existing process of conveyance and selection, but that it is rather indigenous to its present locality. Moreover, while it would indicate a connection at some period between the island and the main-land to the north, yet the number and character of the peculiar species favor the opinion that they are rather a remnant of a flora similar to that of California, which once extended in this direction considerably to the southward of what is now the limit of that flora upon the main-land. And, finally, the presence of so many South American types suggests the conjecture that this, and the similar element which characterizes the flora of California, may be due to some other connection between these distant regions than any which now exists, and even that all the peculiarities of the western floras of both continents had a common origin in an ancient flora which prevailed over a wide, now submerged area, and of whose character they are the partial exponents.

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RECENT LITERATURE.

Huxley and Martin's Biology.[1] — The problem which has so frequently puzzled teachers in biology, namely, to know where to commence their instruction, has been most happily solved by Professor Huxley in his Elementary Biology. He has prepared a series of practical lessons which should be mastered by all who wish to lay a solid foundation upon which to build special knowledge in either zoölogy or botany. The plan followed by Huxley has been to take a small number of plants and animals readily obtainable under ordinary circumstances. Of these a short description is given, followed by detailed laboratory instructions; these should enable every student to know from his own knowledge the facts mentioned in the accompanying description. He will thus gradually learn biological terms, and obtain "a comprehensive and yet not vague conception of the phenomena of life." The plan of thus paving the way to special study by careful, practical work on a few forms is not a new one. The elder De Candolle used to say he could teach all he knew of botany from a few plants, while zoölogists until recently gained their first insight into the phenomena of life mainly from the study of vertebrates, and especially of man. It is only within a more recent period that the great development given to the study of invertebrates has trained a school of zoölogists who have begun at the lower end, so to speak, and who have always retained their predilection for invertebrates in opposition to those who, having studied human anatomy and physiology, have mainly devoted themselves to the vertebrates. The latter have always worked with the immense advantage of attacking their subject with knowledge gained in a field where the constants of the science, contrasted with those known from among invertebrates, were numerous, and where the beginner never stumbled at the outset of his investigations across structural features and phenomena most imperfectly understood.

It is greatly to be hoped that the introduction of such an admirable text-book as that of Huxley and Martin will not only break down the distinction existing between the two sections of zoölogists, but will also lead zoölogists and botanists hereafter to become biologists, while following the special department to which they may from inclination devote themselves as original observers.

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[1] *A Course of Practical Instruction in Elementary Biology.* By Professor Huxley and H. N. Martin. Crown 8vo. 6s. London and New York : Macmillan & Co. 1875.